RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)					DATE February 2004		
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development			R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, R-1 #46				
COST (In Millions)	FY 2003	FY2004	FY2005	FY 2006	FY 2007	FY 2008	FY 2009
Total Program Element (PE) Cost	164.634	81.513	63.121	102.700	55.000	15.000	15.000
Rapid Strike Force Technology LNW-01	10.327	0.819	0.721	0.000	0.000	0.000	0.000
Small Unit Operations LNW-02	30.808	17.704	0.000	0.000	0.000	0.000	0.000
Future Combat Systems LNW-03	123.499	62.990	62.400	102.700	55.000	15.000	15.000

(U) Mission Description:

(U) This program element is budgeted in the Advanced Technology Development Budget Activity because it is developing and demonstrating the concepts and technologies that will address the mission requirements of the 21st Century land warrior. Three broad efforts are being pursued in support of this objective: Rapid Strike Force Technology, Small Unit Operations and Future Combat Systems.

(U) The emerging U.S. vision of future land warfare places strong emphasis on technology supporting early entry of light, efficient land forces. This project is developing technologies that enable mobile and survivable systems for efficient command and control, mobility, surveillance, targeting and reconnaissance as well as effective and adaptive weaponry, which are important aspects of an early-entry capability. The project consists of: the Reconnaissance, Surveillance and Targeting Vehicle (RST-V); Tactical Mobile Robotics (TMR); Metal Storm (MS), Mach 5/50 Technology Development, and the Micro Air Vehicle (MAV) Advanced Concept Technology Demonstration program. These programs are closely coordinated with the U.S. Army, Navy and Marine Corps, and with DARPA's Small Unit Operations (LNW-02) project.

(U) The Services are pursuing new tactical concepts for employing small, easily deployed units as an early entry force to address future contingencies. Their objective is to enable these forces to quickly control a large battlespace with dispersed forces, control the operational tempo, engage enemy targets with remote fire and operate effectively across the spectrum of conflict in severe communications environments. These dismounted forces must be self-sufficient, capable of operating for several days and be sufficiently lean to be quickly inserted anywhere in the world.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, R-1 #46

(U) The U.S. Military requires flexible, effective and efficient multi-mission forces capable of projecting overwhelming military power worldwide. This force must ultimately provide our national leaders with increased options when responding to potential crises and conflicts. To satisfy this requirement, the joint Army/DARPA Future Combat Systems (FCS) program is being developed to provide enhancements in land force lethality, protection, mobility, deployability, sustainability, and command and control capabilities.

(U) **Program Change Summary:** *(In Millions)*	**FY 2003**	**FY 2004**	**FY2005**
Previous President's Budget	165.963	82.387	15.433
Current President's Budget	164.634	81.513	63.121
Total Adjustments	-1.329	-0.874	47.688
Congressional program reductions	0.000	-0.847	
Congressional increases	0.000	0.000	
Reprogrammings	1.000	0.000	
SBIR/STTR transfer	-2.329	0.000	

(U) Change Summary Explanation:

FY 2003	Decrease reflects SBIR transfer and minor repricing.
FY 2004	Decrease reflects congressional undistributed reductions.
FY 2005	Increase reflects additional funds in Project LNW-03 for follow-on technology development for Block 2 and future Future Combat System configurations.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-01

COST (In Millions)	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
Rapid Strike Force Technology, LNW-01	10.327	0.819	0.721	0.000	0.000	0.000	0.000

(U) **Mission Description:**

(U) The emerging U.S. vision of future land warfare places strong emphasis on technology supporting early entry of light, efficient land forces. This project is developing technologies that enable mobile and survivable systems for efficient command and control, mobility, surveillance, targeting and reconnaissance as well as effective and adaptive weaponry, which are important aspects of an early-entry capability. The project consists of: the Reconnaissance, Surveillance and Targeting Vehicle (RST-V); Tactical Mobile Robotics (TMR), Mach 5/50 Technology Development, and the Micro Air Vehicle (MAV) Advanced Concept Technology Demonstration program. These programs are closely coordinated with the U.S. Army, Navy and Marine Corps, and with DARPA's Small Unit Operations (LNW-02) project. This project draws to an end in FY 2005. Programs traditionally budgeted in this project will be reflected in a new PE 0603766E, Project NET-01, to better reflect today's emphasis on network centric warfare.

(U) **Program Accomplishments/Planned Programs:**

	FY 2003	FY 2004	FY 2005
Reconnaissance, Surveillance and Targeting Vehicle (RST-V)	4.142	0.000	0.000

(U) The Reconnaissance, Surveillance and Targeting Vehicle (RST-V) program is designing, developing, testing/demonstrating and transitioning to the Services four hybrid electric drive, lightweight, highly maneuverable advanced technology demonstrator vehicles capable of V-22 internal transport. The vehicle incorporates technological advancements in the areas of integrated survivability techniques and advanced suspension. The vehicle also hosts integrated precision geolocation, communication and Reconnaissance, Surveillance and Targeting sensor subsystems. The RST-V platform provides a mobile quick deployment and deep insertion capable, multi-sensor, battlespace awareness asset for small unit tactical reconnaissance teams, fire support coordinators and special reconnaissance forces. Hardware and lessons learned from this program directly support the Marine Corps-Navy Extending the Littoral Battlespace (ELB) Advanced Concept Technology Demonstration

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-01

(ACTD) as well as address joint U.S. Marine Corps – Special Operations Command (USMC-SOCOM) requirements for the Internally Transportable Vehicle/Light Strike Vehicle (ITV/LSV), Tactical Vehicle, Reconnaissance, Surveillance, Targeting and Acquisition (TV-RSTA) program and High Mobility Multi-purpose Wheeled Vehicle (HMMWV) upgrades. The Marine Corps will develop vehicle concepts and chassis, integrate the DARPA developed components and conduct vehicle performance tests (PE 0603640M) through participation in scheduled Advanced Warfighting Experiments (AWEs) and ACTDs (e.g., Capable Warrior).

(U) Program Plans:

- Completed Technical Performance Measure Verification.
- Completed safety testing at Aberdeen Proving Ground, MD.
- Performed user's demonstrations at Marine Corps Base Quantico, VA and McDill Air Force Base, FL.
- Conducted users' evaluation and assessment with potential USSOCOM/USMC customers at Yuma Proving Ground.
- Perform preliminary mobile power generator design.
- Refurbish and upgrade vehicle 1.
- Deliver vehicles 1, 2, 3 and 4.
- Deliver final report.

	FY 2003	FY 2004	FY 2005
Tactical Mobile Robotics (TMR)	0.100	0.000	0.000

(U) The Tactical Mobile Robotics (TMR) program developed mobile robotic technologies to enable land forces to dominate the battlespace through employment of mobile semi-autonomous robot teams performing challenging missions in complex environments (dynamic urban areas, rugged terrain with high obstacle clutter, etc.). TMR has provided DoD organizations with a team of semi-intelligent, cooperating robot prototype platforms carrying a variety of integrated mission payloads required to conduct activities in risk intensive or inaccessible areas. Operational emphasis was on urban environments and denied areas. TMR prototypes and research artifacts have been transitioned to the DoD Joint Robotic Program where they are being utilized to support additional research on robots.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-01

(U) Program Accomplishments:
- Completed final prototype modifications.
- Transitioned to military departments.

	FY 2003	FY 2004	FY 2005
Mach 5/50 Technology Development	1.189	0.819	0.721

(U) Previously completed tasks in this project demonstrated revolutionary weapon concepts for firing small caliber projectiles at very high rates without the need for internal moving parts. The continuing Mach 5/50 tasks extend the concepts and technologies for leap-ahead performance in tactically relevant, lightweight, medium caliber direct fire weapons. The medium caliber projectiles (50 millimeter or larger bore) will have a minimum muzzle velocity of 1,600 meters per second (~ Mach 5) at 600 rounds per minute or greater. Mach 5/50 technology development will provide multiple services with a low-cost, reliable enabling technology to support a wide range of current/future applications including extended range combat vehicle firepower and lethality, full-spectrum future combat vehicle lethality for active protection systems, high engagement rate naval air defense, critical fixed site defense and improved aircraft self-defense. Portions of the technology development are conducted under an agreement with the Australian Defence Science and Technology Office.

(U) Program Plans:
- Develop medium caliber concepts, detailed performance simulations and technical analyses.
- Fabricate and test critical technology subsystems.
- Complete integration of pre-prototype components and evaluate against simulation-based interim performance parameters.
- Critical design review and complete fabrication of full-function prototype.
- Complete system test and evaluation of full function prototype and validate simulations.
- Conduct firing demonstration and deliver final report.
- Transition hardware and data packages to DoD laboratories for Service-specific engineering and platform integration.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-01

	FY 2003	FY 2004	FY 2005
Micro Air Vehicle (MAV) Advanced Concept Technology Demonstration (ACTD)	4.896	0.000	0.000

(U) The primary goal of the MAV ACTD program is to further develop and integrate MAV technologies into militarily useful and affordable backpackable systems suitable for dismounted soldier, marine, and special forces missions. It will focus on the development of MAVs to accomplish unique military missions, particularly with regard to flight operations in restricted environments. The objective of the MAV ACTD is to demonstrate a backpackable, affordable, easy-to-operate, and responsive reconnaissance and surveillance system. The system will provide the small unit with militarily useful, real-time combat information of difficult to observe and/or distant areas or objects. It will be employable in a variety of warfighting environments, such as mountainous terrain and heavily forested areas. The initial MAV technology development program focused on the technologies and components required to enable flight at small scales, including flight control, power and propulsion, navigation and communications. The MAV ACTD program will develop and deliver small, vertical lift, UAVs to military users for evaluation of the technology and for development of tactics, techniques and procedures. This program is funded in PE 0603764E, Project LNW-03 in FY 2004 and FY 2005.

(U) Program Plans:

- Demonstrate transition MAV (gasoline engine) in military operations in urban terrain exercises and conduct experiments with troops in field trials.
- Evaluate lessons learned and design of transition MAV.
- Develop and demonstrate diesel engine MAV.
- Conduct final experimentation of optimum diesel MAV; transition air vehicles and ground control system to USARPAC and complete final military evaluation.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-01

(U) **Other Program Funding Summary Cost:**

Micro Air Vehicle (MAV) Advanced Concept Technology Demonstration (ACTD)	FY 2003	FY 2004	FY 2005
PE 0603750D, OSD	3.500	3.000	2.000

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RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)					DATE February 2004		
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development			R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-02				
COST (In Millions)	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
Small Unit Operations LNW-02	30.808	17.704	0.000	0.000	0.000	0.000	0.000

(U) **Mission Description:**

(U) The Services are pursuing new tactical concepts for employing small, easily deployed units as an early entry force to address future contingencies. Their objective is to enable these forces to quickly control a large battlespace with dispersed forces, control the operational tempo, engage enemy targets with remote fire and operate effectively across the spectrum of conflict in severe communications environments. These dismounted forces must be self-sufficient, capable of operating for several days and be sufficiently lean to be quickly inserted anywhere in the world.

(U) The objective of the Small Unit Operations Project is to develop critical technologies that will enable small dismounted forces to effectively fight anywhere, anytime. The technology needs are: semi-automated maneuver and strike/fire planning and re-planning that can be employed by commanders who are physically separated but need to be virtually collocated; automated aggregation and mining of information sources to provide a "bubble" of awareness over each warrior and team describing the relevant situation; accurate geographic position estimation, other than GPS, which works in all environments; and radio links and self-forming ad hoc networked communications that "glue" the components together, operate in any environment, are covert and resistant to interference. In addition, these technologies must not significantly increase the dismounted force's mass and power burden. The programs that make up this project include WolfPack, Tactical Sensors, and Advanced Sensing Technologies. This project draws to an end in FY 2005 and programs traditionally budgeted in this project will instead be located in Program Element 0603766E, Project NET-01, to better reflect today's emphasis on network centric warfare.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-02

(U) **Program Accomplishments/Planned Programs:**

	FY 2003	FY 2004	FY 2005
WolfPack	25.803	15.223	0.000

(U) The WolfPack program will develop technologies that would enable the U.S. to deny the enemy use of communications and radars throughout the battlespace. The networked system will be comprised of autonomous, ground-based monitors/jammers that are cooperatively linked to avoid disruption of friendly military and protected commercial radio communications and radars. The specific technologies to be developed include: (1) high efficiency sub-resonant antennas, (2) networking algorithms to allow coordinated access to the spectrum by communicators, jammers and signals intelligence (SIGINT) systems, (3) methods to easily deploy the systems in radio frequency (RF) advantaged sites, and (4) algorithms to rapidly and autonomously detect, classify, identify and jam target signals with low power electronics.

(U) In FY 2003, additional funding was added from the Defense Emergency Response Fund for an accelerated WolfPack capability. Early development of technologies that could lead to a rudimentary, near-real-time geolocation of our enemy's radio communications and surgical denial of those communication systems through the use of a precise coordinated response WolfPack-like system were analyzed. DARPA is developing long-term plans with the U.S. Army for deployment via airborne and deep-launch devices, and is working with the Air Force in a distributed suppression of enemy air defense role. Initial discussions with the Navy are taking place for littoral and force protection missions.

(U) Program Plans:

- Develop enabling technologies.
- Complete system design and performance analysis for a representative prototype system.
- Verify low duty cycle, low power jamming techniques with benchtop experiments.
- Construct and lab test brassboard-jamming subsystems.
- Conduct limited lab tests using brassboard equipment to attack several legacy type communication systems.
- Design, develop, and demonstrate via simulation and field tests the specific technologies developed.
- Studied enabling technologies for potential development of rudimentary WolfPack-capable system.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology 0603764E, Project LNW-02

	FY 2003	FY 2004	FY 2005
Tactical Sensors	1.750	0.000	0.000

(U) The Tactical Sensors program developed a new generation of unattended ground sensors, planning tools, deployment mechanisms, and command and control components that are providing Warfighters with the capability to continuously, remotely and cost effectively detect, track, classify and identify mobile tactical targets in all weather and all terrain. This lightweight, long-life system provides Warfighters with unmanned, high confidence reconnaissance, targeting, and surveillance, for integrated force protection and non-line of sight remote sensing in denied or life-threatening areas of interest.

(U) Program Accomplishments:

- Completed development and field-tested unattended sensor and gateway nodes for detection, classification and tracking of mobile tactical targets such as mobile/cruise missile launchers, tanks, armored personnel carriers, logistics vehicles, light commercial vehicles, and personnel.
- Developed planning and monitoring tools for Warfighters, including emplacement decision aids (EDA) using 3D topography, folia ge, weather, traffic ability and target information. Provided for early Warfighter input, test, evaluation and redesign.
- Integrated and demonstrated a fielded, deep-deployment system, followed by node self-erection and autonomous cluster organization, reporting and geo-location.
- Interfaced to operational command and control networks, such as GCCS-M, GCCS-I, C2PC, or ASAS.
- Demonstrated 70 percent probability of detection at 3,000 meters, 20 meters RMS tracking error at 500 meters, and greater than 90 percent probability of correct target identification at 500 meters, against heavy tactical vehicles operating under reasonably demanding environmental conditions.
- Demonstrated 90 percent probability of detection and correct target classification at 30 meters for personnel; and greater than 85 percent probability of correct identification at 250 meters against light commercial vehicles operating under reasonably demanding environmental conditions.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-02

	FY 2003	FY 2004	FY 2005
Advanced Sensing Technologies	3.255	2.481	0.000

(U) The Advanced Sensing Technologies program will develop a new class of sensors for military surveillance and targeting applications. These sensors will provide surveillance, target detection, tracking, and classification, in day or night and in near all-weather conditions, of time critical mobile targets at distances greater than ten times current capabilities. Such capabilities are required to maintain battlespace dominance in challenging environments where sensor shadow zones may exist, such as around man-made and natural terrain obstacles, under forest canopies and within dense foliage.

(U) Program Plans:

- Develop enabling technologies.
- Develop and field test stationary sensor system to detect, localize and characterize targets.
- Complete preliminary assessment of mobile sensor system to detect, localize and characterize targets in challenging environments.

(U) **Other Program Funding Summary Cost:**

- Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-03

COST (In Millions)	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009
Future Combat Systems LNW-03	123.499	62.990	62.400	102.700	55.000	15.000	15.000

(U) **Mission Description:**

(U) The United States requires strategically deployable, operationally agile, highly lethal and survivable land forces capable of executing the full spectrum of military operations in a joint and multinational environment. This capability must provide our national leaders with increased options to respond to a growing array of crises and conflicts. To satisfy this requirement, the joint Army/DARPA Future Combat Systems (FCS) program was developed to provide dramatic enhancements to current and future land force lethality, protection, mobility, deployability, sustainability, and command & control capabilities.

(U) **Program Accomplishments/Planned Programs:**

	FY 2003	FY 2004	FY 2005
FCS Concept Development	48.000	0.000	0.000

(U) The FCS program will develop network centric concepts for a multi-mission combat system that will be overwhelmingly lethal, strategically deployable, self-sustaining and highly survivable through the use of networked manned and unmanned ground and air platforms, sensors, and weapon systems. The goal of the FCS program is to design such an ensemble that strikes an optimum balance between critical performance factors, including ground platform strategic, operational and tactical mobility; lethality; survivability; and sustainability. The program will develop and demonstrate key enabling technologies, systems, and concepts for transition to a Major Defense Acquisition Program managed by the Army. This system of systems design will be accomplished by using modeling, simulation and experimentation. The FCS unit will be capable of adjusting to a changing set of missions, ranging from warfighting to peacekeeping, as the deployment unfolds. An FCS-equipped force will be capable of providing mobile-networked command, control, communication and computer (C^4) functionalities; autonomous robotic systems; precision direct and indirect fires; airborne and ground organic sensor platforms; and adverse-weather reconnaissance, surveillance, targeting and acquisition.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-03

(U) The FCS program completed Concept and Technology Demonstration, achieved a Milestone B decision in May 2003, and transitioned to the System Development and Demonstration (SDD) phase. A systems integrator has been competitively selected by the FCS program. A group of 31 critical capabilities, with more than 100 candidate technology programs, were identified as integral to the baseline FCS configuration. For spiral development and incremental improvement to the FCS baseline, the Program Management Office (PMO) for FCS Technologies has identified multiple spiral insertion windows, and has begun plans for delivering Increment II capabilities. As part of the spirals, the program will insert 6 deferred systems, supported by more than 15 possible feeder technology programs, and will manage the potential insertion and integration of at least 12 identified technology insertion candidates. Additionally, the PMO will continue to research the technology base, including DARPA, Army, Joint Services, other DoD, industry, and international programs in order to meet future FCS requirements.

(U) The Future Combat Systems Lead System Integrator (FCS LSI), with direction from the Program Manager FCS-Technologies (PM FCS-TE), will develop the FCS Technology Development Strategy, the plan for the integration of enabling technologies and systems over the life of the FCS program. The LSI will coordinate the development of Transition and Integration Plans for the FCS Increment I deferred systems, and will coordinate and support the identification, maturation, and integration of technologies and systems into the FCS baseline. The LSI will coordinate or conduct System of Systems (SoS) and systems experiments to investigate technology and integration readiness. The LSI will assist Training and Doctrine Command (TRADOC) in developing operational concepts and requirements documents for Increment II. The LSI will also provide support to the Army Science Board and DARPA in assessing Technology and Concept Candidates for Increment II.

(U) Program Plans:

- Transitioned program from concept and technology development to system design and demonstration.
- Initiated Force Development Testing and Evaluation activities including limited man-in-the-loop testing.
- Initiated concept and technology demonstration (CTD) for follow-on block improvements.
- Developed a plan for identification and insertion of technologies deferred from baseline FCS platforms.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-03

	FY 2003	FY 2004	FY 2005
FCS Supporting Technologies	75.499	62.990	62.400

(U) DARPA and the Army identified key areas where technology development is needed to support the overall FCS system of systems design: robotic perception, unmanned ground combat vehicles, maneuver command control and communication (C^3), beyond line of sight fires, organic adverse weather unmanned air vehicles and advanced radar and sensor systems.

(U) The Perception for Off-road Robotics (PerceptOR) program will identify and develop revolutionary unmanned vehicle perception prototypes. These perception systems will be flexible enough to operate in off-road environments and will be backed by extensive experimental test data in a variety of operationally relevant terrain and weather conditions. The resulting technology will be applicable to a variety of combat roles and will enable greater confidence in postulating the conditions under which unmanned off-road robotics should be used. The use of advanced remote imagery in aiding off-road navigation will be explored.

(U) The Unmanned Ground Combat Vehicle (UGV) program will develop vehicle prototypes exhibiting advanced performance in endurance, obstacle negotiation, and transportability (small size) based on novel designs unrestrained by the need to accommodate human crews. These prototypes may include unique mobility configurations (traditional wheeled to organic-mimicking, i.e. crawling), exceptional drivetrains, advanced structures/composites, terrain/soil analysis, sensory exploitation and interaction with robotic control architectures.

(U) The UGCV-PerceptOR Integration (UPI) program will exploit the expansion in UGV capability that merges inherent mobility, perception, and use of terrain data into one research platform that also allows for operational UGV considerations via real payload integration. Significant gains in mobility (obstacle negotiation and associated autonomous mobility), endurance, and payload fraction are expected by allowing the vehicle to operate without embedded crew comfort, protection, and fatigue factors. Smaller and lighter vehicles will be demonstrated, enabling a) reduced deployability burden for the associated combat payload, b) reduced combat service support associated with resupply, and c) reduced signature for gains in survivability.

(U) The Future Combat Systems MultiCell and Dismounted Command and Control program enables experimentation with advanced command and control information technology. MultiCell emulates the functionality of an entire tactical combined arms force. It incorporates both

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-03

unmanned air and ground robotic platforms, higher headquarters working at the operational level, and human dismounts. MultiCell also provides commanders with recommended interface functions and workload allocations. MultiCell enables them to experimentally validate their understanding of the dynamics of their complex warfighting organizations. It defines commander interface layouts, functions and displays for maximum flexibility and effectiveness. It recommends capability enhancements in supporting technology for the nomination of sources of information. It supports visualization of current and future operational states. MultiCell enables commanders to successfully prosecute future command and control operations with significantly reduced staff.

(U) The Maneuver C^3 program will develop robust, assured and potentially high data rate connectivity for the Future Combat Systems (FCS) elements along with a command and control architecture to reduce the number of forward deployed Command and Control (C^2) operators. The communications component will develop an integrated architecture that provides for a seamless transition from line-of-sight to non-line-of-sight communications. To enable this functionality, development of new secure waveforms, directional antennas and mobile ad hoc networks will be initiated. The C^2 component will directly leverage the Army's investment in the automation of the Battlefield Functional Areas within the Army Battle Command System (ABCS). Because of the multitude of single aspect systems that feed information in ABCS, large amounts of data are made available to the commander, thus requiring a much larger staff of operators and workstation analysts to complete the fusion function of battlefield data into information for the commander to make decisions. Future operations involving FCS technologies and operational capabilities cannot be restricted by a less responsive C^2 architecture and large support staffs.

(U) Under the Maneuver C^3 program, the Mobile Networked Multiple-Input/Multiple-Output (MIMO) (MNM) project will pursue MIMO communication systems, which have the potential to increase data rates by 10-20 times above current systems. MIMO will use multipath to create parallel channels in the same frequency band thereby increasing spectral efficiency. This effort will demonstrate the MNM capability under dynamic urban Non-Line-of-Sight multipath channel conditions where conventional techniques are degraded. This effort will undertake advanced MIMO technology development and perform field demonstrations of mobile ad hoc networks (MANETs). This effort will culminate in the development of a wideband form-factor (Joint Tactical Radio System (JTRS) cluster 1 size PC card) system.

(U) The Integrated Multifunction Antennas (IMA) project will develop integrated multifunction affordable, low-profile/conformal antennas that achieve directionality via the antenna pattern and/or (distributed) arrays. These arrays will provide significant enhancement to signals intelligence (SIGINT), electronic warfare (EW), and JTRS communications functions in low band frequencies. Research will also be undertaken in this effort that will allow active protection, search, fire control radars, combat identification, and communications in high band frequencies.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-03

These antennas will be designed for use by ground combat vehicles with the objective of low profile and conformability. Multifunction affordable, low-profile/conformal antennas at the JTRS and mm-wave bands will significantly increase the combat capability of ground mobile combat vehicles through increased survivability (low visual and electronic signature; active protection function) and networked operations.

(U) The FCS C^2 program integrates and compresses selected Battlefield Functional Areas in a scaled architecture to support the FCS Unit Cell operations. Through emulation of advanced information technologies and knowledge base engineering, this program develops advanced methods of command and control, integrating the previously stove-piped Battlefield Functional Areas into a single information environment (Commander's Support Environment, CSE) that supports the command and control of manned and unmanned systems. The technical approach is to regulate the flow of information presented to an FCS Commander by moving much of the information/data integration to a hardware/software environment thus allowing the Commander and Battle Managers to leverage existing operational opportunities by focusing on fewer unknowns, and clearly visualize current and future operational end states and dictate the tempo of operations within a variety of environments, while being supported by a significantly reduced staff. The true compression and integration of these functions will provide the FCS commander with information for rapid decision making vice numerous data streams requiring analysis by a large battle staff. The compression of these selected functions would enable a reduction of personnel in the Unit Cell C^2 element, and facilitate anticipatory planning and adaptive execution by the FCS Commander. A top level C^2 architecture (systems and operational) will be developed and validation of the architecture and assessment of performance (e.g., command latencies) will be achieved by conducting a series of four experiments within a simulated environment.

(U) The Netfires (formerly Advanced Fire Support System) program will develop and test a containerized, platform-independent multi-mission weapon concept as an enabling technology element for FCS. NetFires will provide rapid response and lethality in packages requiring significantly fewer personnel, decreased logistical support and lower life-cycle costs, while increasing survivability compared to current direct fire gun and missile artillery. NetFires will allow FCS to defeat all known threats, will be air deployable in C-130 (and smaller) aircraft, and will enhance the situation awareness and survivability of FCS by providing standoff target acquisition and extended-range, non-line-of-sight engagements. The program will develop and demonstrate a highly flexible modular, multimission precision missile and a loitering attack missile that can be remotely commanded. Both missile types will have a self-locating launcher and a command and control system compatible with FCS.

(U) The Organic Adverse Weather Air Vehicle program provides FCS direct and indirect weapons system targeting under all operating conditions at the small unit level. The approach is to develop adverse weather vehicles for operation at two tiers; an upper tier for wide area coverage and a lower tier that allows a close-up view for positive target identification. For the higher tier, the A160 Vertical Take Off and

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-03

Landing Unmanned Air Vehicle program will develop a vehicle for carrying out airborne surveillance and targeting against ground targets. The A160 vehicle will further provide an airborne communications/data link relay between the various ground components and the command nodes and satellite communications. In addition, the A160 will deploy unmanned ground sensors, unmanned ground vehicles, and Micro Air Vehicles (MAVs) and provide a data link between them and the C^2 components. For the lower tier, the Organic Air Vehicle program consists of 2 primary elements: development of lift augmented ducted fan vertical flight vehicles together with their associated flight controls; and evaluation and integration of supporting technologies including non-line-of-sight communications, improved sensor combinations, improved navigation and obstacle avoidance, low-burden multi-vehicle command and control, and acoustic noise reduction. Once the basic flight vehicle is proven, these technologies will be integrated into the flight vehicle and demonstrated in a simulated mission. The OAV program will leverage several programs in DARPA and the services including advanced communications, sensor developments, the MAV ACTD, and UAV command and control programs. The dry system weight (no fuel) of the organic air vehicle to be developed in FY 2005 will be no greater than 112 lbs.

(U) The primary goal of the Micro Air Vehicle (MAV) Advanced Concept Technology Demonstration (ACTD) program is to further develop and integrate MAV technologies into militarily useful and affordable backpackable systems suitable for dismounted soldier, marine, and special forces missions. It will focus is on the development of MAVs to accomplish unique military missions, particularly with regard to flight operations in restricted environments. The objective of the MAV ACTD is to demonstrate a backpackable, affordable, easy-to-operate, and responsive reconnaissance and surveillance system. The system will provide the small unit with militarily useful real-time combat information of difficult to observe and/or distant areas or objects. The system will also be employable in a variety of warfighting environments (for example: in complex topologies such as mountainous terrain; heavily forested areas; confined spaces; and high concentrations of civilians). The initial MAV technology development program focused on the technologies and components required to enable flight at small scales, including flight control, power and propulsion, navigation and communications. The MAV ACTD program is intended to get DARPA-developed small, vertical lift UAVs rapidly into the hands of the users for evaluation and evolution of the technologies; development of tactics, techniques and procedures; and to provide a residual operational capability to active duty forces. The program was funded in FY03 under project LNW-01.

(U) The Jigsaw program develops advanced laser radar (LADAR) sensor systems and technologies. Jigsaw will enable warfighters to accomplish day/night target identification and verification in stressing environments. Stressing environments include targets hidden by foliage and camouflage, and targets in urban settings, such as alleyways. Jigsaw technologies will provide warfighters with reliable combat identification; the LADAR sensor will deliver a visual picture of the target scene.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-03

(U) The Foliage Penetration (FOPEN) Reconnaissance, Surveillance, Tracking and Engagement Radar (FORESTER) initiative supports the Future Combat Systems (FCS) and the U.S. Army Objective Force. It is developing FOPEN Ground Moving Target Indication (GMTI) radar. This radar promises persistent, long-term detection and tracking of enemy combat vehicles and dismounted troops moving in open and forested areas of the battlefield. The technology allows Objective Force commanders to operate with confidence in forested areas. It also detects low-flying aircraft such as helicopters and ultra-lights. Its synthetic aperture radar images support terrain delimitation, road identification, and target tracking in wooded areas. FORESTER is a UHF-band FOPEN GMTI radar for deployment on rotary wing platforms such as the A160 unmanned helicopter. The radar, operating from a hovering platform under calm wind conditions, can achieve calm-weather detection ranges in excess of 30 km against dismounted troops moving in forested areas. It employs adaptive antenna processing and innovative radar waveforms to overcome radio frequency interference and electronic countermeasures in hostile electromagnetic environments. This program was funded in FY 2003 in PE 0603762E, project SGT-04.

(U) The Affordable Adaptive Conformal Electronically Steerable Array Radar (AACER) program develops components and technologies for a helicopter-borne surveillance, targeting, and communications capability and integrates them into an airborne system suitable for use on the next generation Unmanned Airborne Vehicles such as A-160. The technologies being developed include: (1) Ka band Electronically Scanned Antenna Arrays (ESA) which lend themselves to affordable manufacturing techniques; (2) underlying ESA devices such as phase shifting elements and power amplifiers/combiners which operate at Ka band and are affordable yet support the requirements of a high performance radar system; (3) miniature receiver exciter modules capable of generating waveforms for high performance MTI and SAR radar, for communications functions including Combat Identification, and for growth to higher performance and additional functions in radar and electronic warfare; (4) very high performance, small size and low cost signal processors to support high resolution radar surveillance and tracking functions, target imaging and geolocation, and communications functions; (5) signal processing algorithms to optimally exploit the inherent capability of the ESA to support multiple functions simultaneously, each with state-of-the-art operational performance; and (6) integration of all technical elements into a functional system that meets UAV platform constraints, is suitable for flight demonstration on manned and unmanned vehicles, and provides a concrete basis for demonstrating the affordability of production units. If successful, this program will provide a vastly improved intelligence and targeting capability for local commanders by providing a dedicated, rapidly taskable asset with the capability to maintain surveillance of a large region of their battlespace, including areas inaccessible or obscured to larger airborne assets.

(U) The Affordable Weapon System Long Gun program will evaluate and develop a re-useable, long endurance, low cost, joint, unmanned/armed missile system combined with a low-cost hyper spectral seeker. Ducted fan propulsion will provide efficient thrust for long

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-03

endurance. The low cost hyper spectral seeker requires no gyroscopic stabilization. The missile will be launched from a canister carried on a sea or ground vehicle, will fly to a specified target area, and use a hyper spectral seeker operating in visible and near-infrared wavelengths to search for targets. If a qualified target is found, the missile will attack the target with a self-contained munition. If no targets are found, the missile could either be refueled in air, or commanded to return to base. The missile will include a data link back to a human controller/operator to confirm target characteristics, approve engagement, and perform battle damage assessment.

(U) The electro-magnetic (EM) Mortar program will design and demonstrate EM guns (coilgun and railgun) capable of firing modified 120 mm mortar rounds to 420 m/s. The second goal is to evaluate significant system "trade space issues" for implementation including: 1) ammunition integration and compatibility; 2) vehicle integration concerns; 3) system reliability metrics (Barrel life, EM Interference); 4) lethality change due to modification; and 5) system supportability metrics.

(U) The DP-5X program will provide a flight-ready, tactically transportable, vertical take-off and landing unmanned air vehicle (VTOL UAV) to integrate with a gimbaled payload for technology demonstration of the JIGSAW sensor package. The UAV will be employable by a two person team and deployable in a single HMMWV. It will provide lift for a 75 lb payload with 6 hours endurance, 100 kts cruising speed, with nap of the earth agility. Multi-mission capability and modularity will allow the DP-5X to rapidly integrate additional payloads for sensing, communications, and target effects.

(U) The Future Combat Systems Studies, Analysis and Experimentation Project enables the continued Joint analysis and integration of enabling future land warfare concepts and technologies into the U.S. Army Future Combat System program. It enables the rapid analysis of opportunistic concepts and technologies, and provides support for Joint Force effectiveness modeling of DARPA enabling technologies by the TRADOC "Future's Center." The project has three initial focus areas: Air Assault Expeditionary Forces (AAEF), USMA Systems Engineering, and Directed Studies.

(U) The objective of the FCS International Cooperation program is to establish a Science and Technology Project Agreement with Singapore as well as supporting the conduct of FY 2004 Coalition Interoperability wargaming analysis with Singapore and the UK using the DARPA developed Joint Semi Automated Forces (JSAF) Simulation and the OSD developed Joint Warfighting Simulation (JWARS). The Singapore Project agreement will initially support the Mechanized Air Assault, Unmanned Air Vehicles, Coalition Command and Control, and Multispectral Goggles for Dismounted Infantrymen and Scouts.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-03

(U) The Sensor DART program will produce and demonstrate unattended ground sensors into an aerodynamic glider capable of covert delivery from a stand-off at least 45 km with a 50 m or less circular error probability (CEP). Sensor DART will leverage and integrate capabilities derived from the SilentEyes small UAV demonstrator and Steel Rattler (hand emplaced) and Steel Eagle (F-15 air emplaced) projects.

(U) The WolfPack program will further develop the initial capability for close approach electronic warfare. WolfPack was previously budgeted in PE 0603764E Project LNW-01. The overall effectiveness and efficiency of FCS will be improved by this effort through the development of an advanced, collaborative electronic warfare sensing and attack system. This will lead to improved situational awareness of the battlespace for other FCS platforms and will improve their survivability in a wide range of potential conflicts. The improved WolfPack system will be able to suppress enemy air defenses, RF communication systems, and networks either through sensing and passing back targeting information to other FCS weapon platforms for kinetic fire or by collaboratively jamming those systems and networks on its own.

(U) Program Plans:

- PerceptOR
  - -- Conduct perception system prototype development testing in both laboratory and field.
  - -- Conduct evaluation experiments on early perception system prototypes in variety of terrain and environmental conditions.
  - -- Conduct algorithm development for advanced perception behavior.
  - -- Continue algorithm and supporting technology developments for unmanned maneuver.
  - -- Update prototype algorithms and hardware based on supportin g experimentation.
  - -- Explore system implications of degraded component performance (communications constraints, sensor and other faults).

- Unmanned Ground Combat Vehicle (UGCV).
  - -- Conduct UGCV surrogate tests.
  - -- Conduct testing of prototypes against mobility, endurance, and payload fraction metrics.
  - -- Conduct resilience testing on prototypes and make reliability measurements.
  - -- Update prototype hardware with late development technology and prepare for extreme testing conditions.

- UGCV – PerceptOR Integration (UPI).
  - -- Initiate redesign and construction of four Spinner vehicles.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-03

-- Optimize the PerceptOR system for integration onto Spinner.
-- Initiate the selection of weapon payload and integrator.
-- Conduct initial testing of two Spinner-Perception platforms.
-- Complete weapon payload integration onto two Spinner platforms.
-- Conduct second test of two Spinner-Perception platforms to demonstrate autonomy.
-- Conduct initial testing of two Spinner-Payload platforms to demonstrate operation within selected warfighting scenarios.
-- Complete goal-based testing of four Spinner platforms.

– MultiCell and Dismounted Command and Control.
-- Develop prototype command and control interfaces for higher commanders, cell commanders and dismount commanders.
-- Conduct human-in-the-loop experiments with dismounts and higher headquarters, including joint feeds.
-- Develop supporting operational and systems architectural framework products.
-- Develop a supporting C4ISR simulation test-bed to assess the performance of the C2 prototype.

– Maneuver C^3
-- Validate organic, self-contained approaches versus approaches that "reachback" to other systems for C^2.
-- Select wireless communications network architecture(s) for implementation.
-- Demonstrate sub-system components for assured communications in a hostile environment using novel waveforms and beam steering antennas for low probability of detection and anti-jam.
-- Refine Commander's Support Environment (CSE); expand CSE knowledge base and collective intelligence module.
-- Continue to refine and expand supporting simulation.
-- Collect and assess the insights of human-machine interface requirements for training prototypes with the assistance of Army Research Institute.
-- Conduct experiments in support of selected command and control functions for operations with manned/unmanned systems.
-- Complete the development of an initial C^2 experimental demonstrator.
-- Continue experiments of Unit Cell C^2 incorporating limited activities of the dismounted soldier.
-- Extend C^2 architecture to handle inter-unit cell operations, and operations between unit cell and next higher level.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-03

-- Demonstrate an integrated architecture that provides seamless transition from line-of-sight to non-line-of-sight communications via unmanned aerial vehicles and satellite communications.
-- Demonstrate new secure communication waveforms and mobile ad hoc networks using directional antennas.

– Multiple Networked Multiple-Input/Multiple Output (MIMO) (MNM).
-- Validate the MNM concept with field demonstrations of the MIMO-based Mobile Ad Hoc Network (MANET) and custom wideband RF/signal processing designs.
-- Design and demonstrate wideband antenna/RF hardware and the MIMO signal processing.

-- Design and develop a frequency agile MNM showing dynamic spectral efficiency and agility in an operational form factor for use in an urban and rural setting with applications for military and military operations other than war scenarios.

– Integrated Multifunction Antennas (IMA).
-- Develop multi-band antennas integrated into the composite armor and vehicle shell.
-- Incorporate and exploit the electromagnetic properties of the vehicle hull structure.
-- Determine the most beneficial multi-element integration to assure full hemispherical coverage and selective beam placement with respect to the vehicle.
-- Field test of antennas integrated on a Stryker or FCS vehicle mockup.

– Netfires
-- Completed controlled test vehicle demonstrations and initiate guided test vehicle demonstrations.
-- Conducted critical design reviews.
-- Investigated coordination of multiple Netfires missiles.
-- Completed guided test vehicle demonstrations and program transition.

– Organic Adverse - Weather Targeting Vehicles.
-- Initiate competitive contracts for system preliminary design.
-- Obtain and present data for candidate sensors and combinations for evaluation by users and developers.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-03

-- Evaluate emerging communications and command/control systems and select best option(s).
-- Evaluate preliminary designs and downselect to best design(s).
-- Develop ~ 110 lb (dry weight) flight vehicle and demonstrate robust flight stability.
-- Ground test A160 anti-icing systems, sand/dust/salt protection systems, and precision flight systems.

– Micro Air Vehicle.
-- Demonstrate transition MAV (gasoline engine) in military operations in urban terrain exercises and conduct experiments with troops in field trials.

– Jigsaw: LADAR Sensing for Combat ID.
-- Establish a Joint DARPA-NVESD (U. S. Army Night Vision and Electronic Sensors Directorate) JIGSAW Program.
-- Develop a form, fit, & function Jigsaw Sensor for integration onto the DP-5X (FCS Class III) Unmanned Air Vehicle.
-- Develop real-time on-board registration and processing capability.

– Foliage Penetration (FOPEN) Reconnaissance, Surveillance, Tracking and Engagement Radar (FORESTER)**.**
-- Demonstrate detection of slowly moving ground targets in foliage by rotorcraft-mounted Ground Moving Target Indication (GMTI) radars through measurements, simulations and analyses.
-- Design, assess, and evaluate a brassboard FORESTER hardware system.
-- Design, assess, and evaluate a form-fit-and-function FORESTER hardware system for rotorcraft installation.
-- Conduct end-to-end system performance tests that include aircraft effects under static and dynamic conditions.
-- Conduct airborne flight-testing and demonstrate performance with the fully integrated FORESTER/aircraft system.

– Affordable Adaptive Conformal Electronically Steerable Array Radar (AACER).
-- Initiate competitive contracts for system preliminary design.
-- Evaluate preliminary system designs, production cost estimates, and results from critical antenna technology demonstrations and down select to best design(s).
-- Develop prototype modules and perform subsystem tests, system integration, and rooftop testing.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-03

-- Perform flight tests, system characterization, and simulated military missions in manned aircraft, and finalize production cost estimates.
-- Modify designs/software based on flight test results, and integrate to unmanned air vehicle.
-- Train military operators and perform simulated military mission tests and evaluation.

– Affordable Weapon System.
-- Select an existing airframe as basis for missile design.
-- Replace engine with ducted fan.
-- Select and modify existing seeker.
-- Develop avionics package to support long-endurance flight.
-- Design and install port to support air-to-air refueling.
-- Conduct inert flight tests.
-- Integrate warhead.
-- Conduct final flight tests and live demonstration.

– EM Mortar
-- Conduct modeling and simulation to design the launcher, power supply, and projectile modifications for coupling to the launcher.
-- Design launcher for mortar launch application and develop specifications for the power system coil and rail guns.
-- Fabricate coil and rail gun launchers.
-- Conduct laboratory testing of the launchers with capacitor-based power systems.
-- Assess large-scale manufacturing issues for capacitors and demonstrate operation in a full-size module.
-- Conduct ammunition and weapon system testing.

– DP-5X
-- Design and fabricate airframe.
-- Test surrogate rotors.
-- Integrate airframe with automatic controls.
-- Conduct airframe thermal and vibration testing.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-03

-- Integrate sensor package with airframe.
-- Conduct flight tests of airframe with sensor package.

– Studies/Analysis/Experiments.
-- Conduct systems engineering studies.
-- Conduct experiments with Air Assault Expeditionary Force.
-- Conduct FCS related directed studies and analysis.

– International Cooperation
-- Jointly explore and develop innovative mechanized air assault force concepts of operations through enabling technologies.
-- Evaluate the operational performance of the DARPA Organic and Micro Air Vehicles in complex terrain environments, e.g. urban and jungle.
-- Implement Command Post of the Future (CPoF) to exchange information and concepts on command and control and explore interoperable architecture demonstrating plug and operate capabilities.
-- Assess the operational utility of the CPoF Battleboard as the basis for defining future collaboration between Singapore MINDEF and the U.S.
-- Conduct interoperability wargaming.
-- Assess the feasibility of using or developing Singapore's quantum dot technology research for "next generation" multispectral goggles, and if feasible, to explore possible collaboration to develop this application with the US army.
-- Conduct perception system prototype development testing in both laboratory and field.

– Sensor Dart
-- Develop initial design concept that addresses separate Sensor Dart versions for both a Unit of Employment deployment and a Unit of Action deployment.
-- Conduct detailed trade studies and systems analysis will be performed to maximize system capabilities.
-- Generate designs detailing the glider, dart, sensor, electronics, and communications subsystems.
-- Integrate Sensor Dart subsystems for flight testing.
-- Develop and flight test prototype.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-wide BA3 Advanced Technology Development	R-1 ITEM NOMENCLATURE Land Warfare Technology PE 0603764E, Project LNW-03

– WolfPack
  -- Reduce form factor size of initial WolfPack capability hardware to suit multiple delivery options under the FCS architecture.
  -- Expand initial WolfPack sensing capabilities to cover additional enemy military systems waveforms.
  -- Optimize initial WolfPack power generation and management systems for longer endurance.

(U) **Other Program Funding Summary Cost:**

	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007
PE 633005 Army	162.000	114.000	111.000	40.000	40.000